

## CLAIMS

1. An instrument for analyzing a gas comprising  
a detection cell for the gas being analyzed,  
a block having a sample gas inlet including a sample gas orifice, a  
calibration gas inlet including a calibration gas orifice, and a gas outlet,  
a plurality of passageways in the block through which gas flows,  
entering one of said passageways through at least one of said orifices to  
flow past said detection cell and out said gas outlet, and  
a valve mounted to the block having different positions that  
directs the flow of gas along at least one of said passageways.
2. The instrument of Claim 1 where said orifices are sized so that,  
with gas entering the instrument at an inlet orifice pressure within a  
predetermined range, the flow rate of gas through the instrument is  
within a predetermined range.
3. The instrument of Claim 2 where the predetermined inlet orifice  
pressure range is from 1 to 100 pounds per square inch gage.
4. The instrument of Claim 3 where the predetermined flow rate  
range is from 0.5 to 7 standard cubic feet per hour.
5. The instrument of Claim 3 where the orifices have an area from  
0.00001 to 0.0005 square inch.
6. The instrument of Claim 3 where the orifices are substantially  
circular and have a diameter from 0.004 to 0.022 inch.

1 7. An instrument for analyzing a gas that is at a variable pressure  
2 elevated above atmospheric pressure, said gas flowing through the  
3 instrument to exit the instrument via a gas outlet at atmospheric  
4 pressure,

5 said instrument comprising

6 a block having a sample gas inlet,

7 a detection cell mounted to the block past which the sample gas  
8 flows,

9 a valve mounted to the block, said valve having a first sample gas  
10 position that allows sample gas to flow past the detection cell and a  
11 second position that prevents sample gas from flowing past the  
12 detection cell,

13 a first sample gas flow path extending from the sample gas inlet  
14 through the valve and past the detection cell to the gas outlet, and

15 a second sample gas flow path in communication with the first  
16 sample gas flow path that diverts a portion of the sample gas to flow  
17 along said second sample gas flow path and exit the gas outlet so long  
18 as sample gas flows into the sample gas inlet at said elevated pressure,

19 said first and second sample gas flow paths each including a  
20 restricted orifice sized to prevent a build up of excessive pressure when  
21 the valve is in the second position.

22  
23 8. An instrument that provides a quantitative measurement of an  
24 analyte in a gas, including

25 a detection cell that provides an indication of an amount of  
26 analyte present in the gas,

27 a valve having a plurality of different control positions,

28 a calibration gas inlet in communication with a gas outlet  
29 through a first flow path including the valve and the detection cell,

1 a sample gas inlet in communication with the gas outlet through  
2 a second flow path including the valve and the detection cell,  
3 a sample gas orifice along the second flow path, and  
4 a bypass orifice positioned between the sample gas orifice and  
5 the gas outlet that allows at least a portion of the sample gas to exit the  
6 gas outlet,  
7 said bypass orifice being sized relative to the sample gas orifice to  
8 prevent a build up of excessive pressure within the instrument when  
9 the valve is in a selected control position.

10  
11 9. The instrument of Claim 8 where the sample gas orifice is always  
12 in communication with the gas outlet through the bypass orifice  
13 regardless of the position of the valve.

14  
15 10. An instrument that provides a quantitative measurement of an  
16 analyte in a gas, including

17 a block having a sample gas inlet, a calibration gas inlet, and a  
18 gas outlet,

19 a detection cell mounted to the block to enable said cell to be  
20 removed therefrom, said detection cell providing an indication of an  
21 amount of analyte present in gas flowing past the cell,

22 a valve mounted to the block having a plurality of different  
23 control positions,

24 said calibration gas inlet being in communication with the gas  
25 outlet through a first flow path including the valve and the detection  
26 cell with the valve in one control position,

27 said sample gas inlet being in communication with the gas outlet  
28 through a second flow path including the valve and the detection cell  
29 with the valve in another control position,

1 a sample gas orifice in the block along the second flow path, and  
2 a bypass orifice in the block positioned between the sample gas  
3 orifice and the gas outlet that allows at least a portion of the sample  
4 gas to exit the gas outlet,

5 said bypass orifice being sized relative to the sample gas orifice to  
6 prevent a build up of excessive pressure in the instrument when the  
7 valve is in a predetermined control position.

8  
9 11. The instrument of Claim 10 where the bypass orifice and sample  
10 gas orifice each have a predetermined area, and the area of the bypass  
11 orifice is at least two times greater than the area of the sample gas  
12 orifice.

13  
14 12. An instrument for analyzing a gas including  
15 a block having a sample gas inlet, a calibration gas inlet, and a  
16 gas outlet,

17 a detection cell past which the gas being analyzed flows,  
18 a scrubber detachably connected to the block,  
19 a valve mounted to the block, said valve having a closed position,  
20 a sample gas position, and a calibration gas position,

21 a first passageway in the block that bypasses the scrubber and  
22 extends from the calibration gas inlet through the valve and the  
23 detection cell to the gas outlet,

24 a second passageway in the block having a first branch extending  
25 from the sample gas inlet through the block to an outlet and a second  
26 branch in the block extending from a first inlet through the valve and  
27 the detection cell to the gas outlet, said scrubber being connected  
28 between the first outlet and the first inlet to enable the sample gas to  
29 flow through the scrubber prior to flowing through the valve and past

1 the detection cell,

2 a sample gas orifice along the first branch of the second  
3 passageway upstream of the first outlet,

4 a third passageway placing sample gas that flows through the  
5 sample gas orifice in communication with the gas outlet at all times,  
6 enabling at least a portion of the sample gas to flow through the third  
7 passageway and exit the gas outlet, and

8 a bypass orifice along the third passageway downstream of the  
9 sample gas orifice,

10 said orifices being sized so that, with gas entering the instrument  
11 at an inlet orifice pressure within a predetermined range, the flow rate  
12 of gas through the instrument is within a predetermined range.

13  
14 13. The instrument of Claim 12 where at least a portion of the sample  
15 gas always exits the gas outlet as long as sample gas flows into the  
16 sample gas inlet at a pressure greater than the pressure at the gas  
17 outlet, the inlet orifice pressure varying within the range from 1 to 100  
18 pounds per square inch gage, and the flow rate being in the range from  
19 0.5 to 7 standard cubic feet per hour, and the orifices having an area  
20 from 0.00001 to 0.0005 square inch.

21  
22 14. The instrument of Claim 13 where

23 with the valve in the closed position or in the calibration gas  
24 position, essentially all of the gas exits the gas outlet, and,

25 with the valve in the sample position, one portion of the sample  
26 gas flows past the detection cell and another portion exits the gas  
27 outlet.

1 15. The instrument of Claim 12 where the bypass orifice and sample  
2 gas orifice each have a predetermined area sized so that, with gas  
3 entering the instrument at an inlet orifice pressure within a  
4 predetermined range, the flow rate of gas through the instrument is  
5 within a predetermined range.

6  
7 16. An instrument for analyzing a gas comprising  
8 a block having a sample gas inlet, a calibration gas inlet, and a  
9 gas outlet,  
10 a detection cell for the gas being analyzed mounted to the block,  
11 a plurality of passageways in the block through which gas flows,  
12 entering one of said passageways through the one of the gas inlets to  
13 flow past said detection cell and out said gas outlet, and  
14 a valve mounted to the block having different positions that  
15 directs the flow of gas along at least one of said passageways.

16  
17 17. The instrument of Claim 16 including means for preventing a  
18 build up of excessive pressure within the instrument.

19  
20 18. An instrument for analyzing a gas comprising  
21 a block having a sample gas inlet, a calibration gas inlet, and a  
22 gas outlet,  
23 a detection cell for the gas being analyzed mounted to the block,  
24 a passageway in the block through which gas flows, entering said  
25 passageway through one of the gas inlets to flow past said detection  
26 cell and out said gas outlet, and  
27 a valve mounted to the block having a first position enabling a  
28 calibration gas to flow past the detection cell and a second position  
29 enabling a sample gas to flow past the detection cell,

1 a detachable scrubber mounted to the block downstream of the  
2 sample gas inlet and upstream of the detection cell, said sample gas  
3 flowing past the scrubber when the valve is in the second position,  
4 an orifice structure along the passageway that regulates the  
5 pressure within the scrubber.

6  
7 19. The instrument of Claim 17 having means for preventing a build  
8 up of excessive pressure within the instrument, said means including  
9 the orifice structure.

10  
11 20. The instrument of Claim 17 where, with the in the second  
12 position, one portion of the sample gas flows past the detection cell  
13 and another portion exits the gas outlet.